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ABSTRACT

To ensure that the classroom of the next century offers all its potential, schools must plan for changes in technology that will bring opportunities that currently can only be imagined. Virtual reality is already amazing, and has the potential to be the most effective method for training people who learn and remember best by doing. Verbal computer communications, multimedia instruction, and global information retrieval all promise to revolutionize education. By the 21st century, students may choose what schools to attend, as well as whether they wish to be educated at home or at school. Competitive public schools are gaining more and more support. Principals of the future will have more power and responsibility than they do today. Some of the issues educators must face now to be ready for the future include: (1) teaching middle school students to program in BASIC; (2) developing a composite laboratory in the school; (3) developing community and home computer use; (4) encouraging computer use by every class, but not necessarily in every classroom; (5) avoiding unproven innovative equipment; (6) supporting teacher education in computer use; and (7) using hardware effectively. Examples of effective computer use are taken from three high schools. (Contains 8 references.) (SLD)

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Technology in the Classroom: Planning for Educational Change

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What will the classroom of the 21st century hold? The rapid changes in technology will make the school building optional and computer competence vital.

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Ten years ago, most high schools were getting their first lab of microcomputers. For some, the microcomputers replaced the terminals that used a time-sharing mainframe; for others, it was the school's first experience with computers.

In most cases, the microcomputers were used by math or business teachers—sometimes by both. Each unit had 64K of memory, one or two disk drives, and a monochromatic screen. A few had printers. Life was simple.

The computer sciences curriculum was also simple: programming, word processing, spreadsheets, data bases, and accounting. Everyone worked at about the same pace; the class was teacher-directed. Typing was usually a prerequisite, and in some schools, so was algebra. Freshmen usually had to wait until their sophomore or junior year to enroll in a course.

Finding a teacher or teachers who knew or wanted to learn how to use the computers was often difficult. In most high schools, only one or two teachers used the computers regularly. Colleges were just beginning to train computer teachers and industry was hiring them as fast as they were produced. It was easy to mass produce the equipment, but much harder to produce knowledgeable computer teachers.

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By 1985, 39 states still had no certification requirements for computer teachers, although many did encourage teachers to take advantage of state-run workshops. Thirty-six states and the District of Columbia had computer coordinators who served as the state focal point for all computer education activities.

That was almost a decade ago. What's to come 10 years from now? How can we be prepared for the changes the 21st century holds?

The Technology of the Future

• **Virtual Reality.** This innovation is already amazing us. The user puts on a helmet and is immersed in the sights and actions of a computer-generated feedback system that responds to the actions and movements of the wearer.

Today, the programs are in their early stages. By 2002, we will be able to fight in the Civil War, fly a jet plane in combat, practice throwing touchdown passes, and a host of other "real as life" simulations.

Virtual reality has the potential to be the most effective method for training people who learn and remember best by doing.

• **Verbal Computer Communications.** Technology will recognize voices and respond to verbal commands. We won't type a letter. Instead, the letter we dictate will be put in proper form, checked for spelling and grammar, and produced in any language we wish.

Lights will come on, doors will unlock, cars will move—all by voice command.

• **Multimedia Instruction.** Learning through all the senses will replace learning by hearing or seeing (reading). Touch, smell, taste, sight, and sound will all be used to make learning a totally sensuous experience.

In the next century, students will be able to "experience" a walk in a jungle, a desert trip on a camel, or a space flight to Mars. The early stages of this technology can be found at Disney World, where movement, sight, sound, and smell add to the feeling of reality on some of the "rides."

• **Global Information Retrieval.** This technology will become reality sometime this year when GM Hughes Electronics Corporation implements a direct-to-home satellite digital video and audio service that will deliver more than 100 channels of programming and can be received with a low-cost 18-inch satellite receiver.

By the year 2002, communication between home and satellite will be a two-way flow allowing selected information to be collected and sent to anyone anywhere. Similar operations will be available over existing phone lines.

Replacing old jobs (skills) with new ones has always been a by-product of progress. Already, the middle class worker is finding that many of the good jobs that bring better salaries today, didn't even exist five years ago.

Gene-splicing, laser manufacturing, computer-controlled environments, robotic intelligence—all will be growth industries of the next century. Humans will no longer type, file papers, lay bricks, repair cars, or deliver mail.

The Necessary Skills

The job force of the 21st century will be much more varied than the job force of today. The difference between the high-paying jobs and the low-paying jobs will become more pronounced and will be based on the employees' ability to learn new information and act quickly on that information.

Self-directed learners will be in great demand—people who can select what to learn and then teach themselves. This is an important skill now, but it will be even more vital in the future.

Problem solvers who can look at vast amounts of data and information and select the important points, put them together, and evaluate their own results are always in demand, but in the 21st century, those skills will be expected of all educated persons. This ability will separate those who take orders from those who give them.

Technology will allow more small businesses to exist and compete favorably with corporate giants. Entrepreneurs will flourish if they have this valuable skill.

Competitive public schools are gaining more and more support. By the 21st century, students will not only choose what school they will attend, but also whether they wish to get their education in the school or at home.

Computer competency will be vital. Computers will run computers, but students will need to learn how to program computers so they will understand what computers can and cannot do. This doesn't mean humans will do the programming, but they will need to understand what is involved and how it is done.

People who do not know how to command the technology at their disposal will not be put in positions of control.

Communication will be the most important skill: communication with other people, with computers and technology, with other ideas and cultures, with related processes and techniques. Information may come from anywhere in the world, in any language, and at any time. Understanding that information, being able to act on it, and then being able to communicate wishes to others will be a valuable asset.

The Schools of the Next Century

Competitive public schools are gaining more and more support. By the 21st century, students will not only choose what school they will attend, but also whether they wish to get their education in the school or at home.

Many more private schools or privately operated public schools will be competing for students. Many will

tailor their programs and curriculum for special groups: gifted students, students with special talents, interests, and needs. Outstanding principals and teachers will be paid more than those who are less successful attracting and keeping students.

Teachers as facilitators, coupled with technology that allows different students to learn different things in different ways, will be much in demand. Teaching students how to learn rather than what to learn will require facilitators rather than lecturers. Teachers who can inspire, motivate, guide, create, and manage the educational progress of their students will be in demand and will command higher salaries.

Crossroads of informational flow, whether they exist in public school buildings, home schools, or private schools, will become the gathering place for teachers and students. Being able to access this information, sort selectively through it, evaluate and synthesize its content for understanding, will become increasingly important as the quantity of such information continues to grow.

Remote learning locations, in contact with and guided by a group of skilled educational facilitators, will provide many of the special educational requirements of high schools in the 21st century. Having the best authorities electronically available for two-way interaction will provide a richness that most schools could not otherwise afford. Experiments done in space, witnessed and directed by Earth-bound students, as well as Earth-bound experiments witnessed by space station students, will become a part of the next century.

Principals for the 21st Century

As educational entrepreneurs responsible for the well-being and success of the school, principals of the future will have more power and responsibility than they do today. Since students will no longer be required to come to school, principals' job descriptions will include recruiting students. Success will determine the size of the budget. Principals will be more like company presidents trying to run a high class school with success and style.

Locating and attracting the best teachers will remain an extremely important factor. Within a competitive educational system, excellent teachers will require higher salaries and excellent support and materials. Principals will need to judge teachers' value to the school and reward them accordingly.

The positive image presented to the community will determine how many students elect to attend the school. Principals' success in this area will be measured by student enrollment. Interaction with area colleges and employers will also be important.

Creating an image and reputation will be as important as creating a good curriculum.

Securing teacher support for short-term and long-term goals will be aided by the principals' ability to hire teachers they want and to get rid of those who don't work out. Principals must be leaders who excellent teachers follow or managers who excellent teachers trust and work with to build a better school.

Coordinating the total program, with the power and responsibility to do so, will require excellent people skills, good financial skills, and the ability to find an educational need and fill it. Principals may not need to be all things to all students, but they will have to do what they do well enough to please students, parents, and the district and state officials who evaluate the quality of the graduates.

Things To Consider Now

The ability of technology to allow new methods of learning and instruction will greatly alter many of our current concepts of what a school should be and how it should operate. Fortunately, many of the important changes do not require large investments in new hardware, but new ways to use existing hardware.

As educational entrepreneurs responsible for the well-being and success of the school, principals of the future will have more power and responsibility than they do today.

Here are some issues educators should consider now, in preparation for the future:

- **Teach middle school students to program in BASIC.** BASIC is less structured; it is easy to add or make changes and to see at once the effects of each change. It lends itself to creative expression, is easy to learn, and is used on most home and school comput-

ers. BASIC is still the most popular computer programming language used in the world today.

BASIC is also an excellent language to help students develop higher order thinking skills. The emphasis here should be on developing self-directed learners with exceptional and creative problem-solving ability, not professional programmers.

Learning a second or third language—such as PASCAL or COBOL—is relatively easy.

Low self-esteem is a major problem at the middle school. A project like this will not only reduce dropouts and identify hidden talents, but also provide the high school with students who are more goal-oriented and capable of accomplishing those goals.

• **Develop a composite lab in the school.** You cannot afford to keep up with the many and rapid changes in technology. Each new step may require 25–30 new pieces of equipment so everyone in a class can do the same thing at the same time.

Develop computer stations with self-contained instructions so students can learn on their own with occasional help from the teacher or fellow students. This will allow students to learn at their own pace and makes multiple copies of software or site licenses unnecessary. A network is not necessary, because the student moves from station to station; the software does not move from computer to computer.

Such a lab allows valuable and more frequent additions to your program at minimal cost. It also develops in the students the ability to select the best tool to fit the job at hand.

Older equipment does not go out of date, as it will continue to do what it was purchased to do, leaving the new tasks to the new equipment.

The most important part of such a lab is a teacher who enjoys learning new things and is able to establish an environment in which students will assume a greater responsibility for their learning. This teacher becomes a facilitator rather than a dispenser of information.

• **Develop community and home computer use.** Most libraries and many homes and community organizations have computers. If a self-paced, individualized curriculum is used in the schools, students can use computers in schools and out of schools. Some schools keep their computer labs or libraries open after school or on weekends so students and community members can use the equipment.

• **Encourage computer use by every class...but not necessarily in every classroom.** Students in almost every class and subject in the school can benefit from computer skills. It is nice when computers can be located in the classroom, but a lot can be done to encourage computer use outside the classroom if the assignments are made far enough ahead of time and the teacher is committed to preparing students for the next century. Reports, graphs, projects—all kinds of assignments can be checked, created, compiled, presented, or improved by knowledgeable computer users.

A surprising number of parents find a way to get a computer in the home when their children show they can use it to do more than write letters, play games, and run drill software.

• **Avoid "state of the art" equipment.** Wait until the second or third generation. That gives the manufacturer time to correct, improve, modify, and support the new equipment. Most existing equipment is only being used at a small percentage of its potential.

• **Support teachers who are willing to learn how to command the new technology.** They often are the best ones to teach students how to be self-learners. It seems that those who want to learn badly enough to do it themselves are also enthusiastic about helping others learn. No amount of equipment is as important as a good teacher who is able to get students involved and excited about being self-directed, individualized self-learners.

The ability of technology to allow new methods of learning and instruction will greatly alter many of our current concepts of what a school should be and how it should operate.

The success of your program will be directly related to the quality and enthusiasm of these teachers.

• **Use hardware effectively.** The easy part is buying hardware. The hard part is using it well. One takes money, the other takes good teachers. The hardware will be out of date in three years, but in the hands of a competent teacher, it will continue to do what it was purchased for long after that.

However, if you have plenty of money, a host of vendors will gladly show you the finer points of their automated, user-friendly, state-of-the art equipment. Hypermedia, multimedia, video-enhanced didactic presentations, CD-ROM, color scanners, accelerator cards with cache memory, LANs, ethernets, internet, and a host of other systems, peripherals, parts, pieces, bytes, and bits can all be yours.

But, they all require a teacher who will use them effectively. Many companies provide three days of intensive training to show what their people can do with their products, but what can your people do with those products?

In Summary

Oliver Wendell Holmes wasn't talking about new technology when he said, "The great thing in this world is not so much where we are, but in what direction we are headed." Summarized here are a few things to get you headed toward the 21st century:

- Identify, train, and support teachers who can teach by being facilitators.
- Encourage teachers to develop self-directed learners who help decide what to learn and how to learn it.
- Teach computer programming over a three or four-year period to develop lasting problem-solving skills.
- Improve communication skills by listening, speaking, writing, reading, and showing—and do it with and without a computer.
- Train as many of your staff members as possible to be competent in the use of computers.
- Only hire teachers who are computer competent and let the universities and colleges know this is your policy.
- Select technology that compliments teachers' abilities and strengths so you can ensure a steady and consistent growth toward the 21st century.

Start now, the clock is running.

To Illustrate

CASEY JR.-SR. HIGH SCHOOL
306 East Edgar Ave.
Casey, Ill. 62420
Contact: Rem Woodruff, teacher
(217) 932-2175

Casey is a small school in rural Illinois with about 480 students in grades 7–12. Rem Woodruff runs an open learning experience with students of different ages, abilities, and experiences—often working in the computer lab at the same time.

Each student keeps track of his or her accomplishments. BASIC programming is divided into six levels, with problem solving and self-learning as the prime goal.

As skills improve, students may branch off to learn word processing, spreadsheets, databases, or applications from the LAN. Advanced students may also select special projects like robotic control, a special software package like Harvard Graphics, or perhaps another language (PASCAL).

Rem acts as a facilitator, guide, coach, and motivator, accommodating students assigned to the class as well as study hall students who drop in. An increasing number of seventh graders arrive at the lab already having mastered the first two levels of BASIC.

Students who graduate and go on to college report that they are ahead of most of their peers and find basic college computer classes boring.

MCCULLOUGH HIGH SCHOOL
3800 South Panther Creek
The Woodlands, Tex. 77380
Contact: Larry McHaney, teacher
(713) 367-1025

Larry McHaney was honored nationally for his innovative use of computers. His students used computer-aided design software to develop a lunar habitat. Computers were used to simulate a flight to the moon, monitor the vital signs of "astronauts," and create press releases and other support documents.

As a result of the project, students have been offered summer positions at the Johnson Space Center and a number of students have continued post-secondary education in the fields they began as part of the project.

ADLAI STEVENSON HIGH SCHOOL
1 Stevenson Rd.
Lincolnshire, Ill. 60069
Contact: Sam Richie, teacher
(708) 634-4000

Sam Richie has been involved with computers at Adlai Stevenson High School for more than a dozen years. The school has five fully equipped computer

labs, each with its own LAN. Programming in BASIC, PASCAL, and LOGO; word processing; desktop publishing; CAD; and computer graphic arts are all offered. In addition, many classrooms have one or more computers for student and teacher use.

The physics classes use Vernier kits and computers to interface with equipment in the physics labs; the math classes use software such as Math Supposer; the art classes use computers for graphic arts; the drafting classes use CAD; and the coaches use computers for scouting and planning.

Most of the teachers (about 85 percent) use computers for their personal work; about 50 percent use computers in the classrooms for instruction.

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KUDOS

This *Curriculum Report* was prepared by Henry A. Taitt, associate professor, College of Education, Eastern Illinois University, Charleston.

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